CLASSIFICATION RESTRICTED CENTRAL INTELLIGENCE AGENCY

Scientific - Electronics, transients

REPORT

INFORMATION FROM FOREIGN DOCUMENTS OR RADIO BROADCASTS CD NO. STAT

COUNTRY

USSR

DATE OF

INFORMATION 1951

**SUBJECT** HOW

PUBLISHED

DATE DIST. / L May 1952

WHERE

**PUBLISHED** 

LANGUAGE

Moscow

. Book

NO. OF PAGES 5

**PUBLISHED** 

1951

SUPPLEMENT TO

REPORT NO.

Russian

THIS IS UNEVALUATED INFORMATION

SOURCE

Perekhodnyye i Ustanovivshiyesya Protsessy v Impul'snykh Tsepyakh, Gomenergoizdat, 220 pp.

STAT

TABLE OF CONTENTS AND BIBLIOGRAPHY OF YA. Z. TSYPKIN'S BOOK, "TRANSIENT AND STEADY-STATE PROCESSES IN PULSE CIRCUITS"

### AUTHOR'S NOTE

This book is given to the theory and methods of calculating transient and steady-state processes in pulse circuits. Problems related to processes in linear electric circuits and mechanical systems in pulse operation are discussed. The theory developed is applied to the study of systems with pulse feedback (systems of discontinuous regulation and control) and systems with relay feedback. The simple and unique method of calculation is illustrated by practical examples, and calculation formulas and graphs are supplied. The book is intended for scientific workers, post-graduate students, and engineer researchers working in the field of electrical engineering, radio engineering, and automatic control.

## TABLE OF CONTENTS

	Page
Forevord	3
Chapter I. Principles of the Discrete Laplace Transform	
1. Step Functions and Difference Equations	9
2. Definition of the Discrete Laplace Transform	J.5
3. Basic Rules and Theorems	18
4. Solution of Difference Equations	35
(1) Network Theory	36

. - 1 -

RESTRICTED CLASSIFICATION ATE NAVY

Γ

#### RESTRICTED

STAT



	Page
(2) Distribution of Voltages on a String of Insulators	39
(3) Amplification Factor of an N-Stage Amplifier	41
5. Expansion Formulas	47
6. The Inverse Discrete Laplace Transform. Inversion Formula	52
7. Relationship Between the Discrete Laplace Transform and	
Fourier Series	61
Chapter II. Pulse Circuits	
1. The Concept of Pulse Circuits	64
2. Equations of the Pulse Circuit	67
3. Transfer Coefficients of a Pulse Circuit	71
4. Transient and Steady-State Processes in Pulse Circuits	82
(1) Step Input (Rectangular Pulse)	83
(2) Harmonic Input	87
(3) Linear Input (Pulses of Successively Increasing	
Amplitude)	91
5. Time and Frequency Characteristics	93
6. Thermal Conditions of a Mechanism in Interrupted Operations	102
7. The Wide-Bank Low-Frequency Amplifier	105
8. The Inverter	115
9. The Action of Impluse Forces Upon Mechanical Systems	122
Chapter III. Systems With Pulse Feedback	
1. Continuous and Pulse Feedback	128
2. Pulse Elements	129
3. Equations of Systems With Pulse Feedback	131
4. Transient and Steady-State Processes	138
5. Stability of Systems With Pulse Feedback	148
6. Systems With Pulse Feedback and Small Values of the Period	
Between Pulses T	155

- 2 -

# RESTRICTED

Γ

RESTRICTED Page 7. A System for Automatic Temperature Regulation 155 Chapter IV. Systems With Relay Feedback 1. Relay Feedback and Characteristics of Relay Elements 171 2. Stability and Self-Excited Oscillations 173 3. A System for Automatic Temperature Regulation 186 4. A System for Automatic Stabilization of an Airplane's 191 5. The Vacuum-Tube Oscillator 198 Appendixes. Table P-1. Correspondence of Operations in the Discrete Laplace Transform 205 Table P-2. Step Functions and Their Representation 211 115 Bibliography 218 BIBLIOGRAPHY Andronov, A. A., and Khaykin, S. E., Theory of Oscillations, ONTI, 1937, 170 pp. 2. Andronov, A. A., and Bautin, N. N., "The Motion of a Neutral Airplane Equipped with an Autopilot and the Theory of Point Transformations," Dok?ady Akademii Nauk SSSR, Vol XXXXIII, No 5, p 197. 3. Andronov, A. A., And Bautin, N. N., "Stabilization of the Course of an Airplane Having an Autopilot With Constant Servomotor Velocity and a Zone of Instability," Doklady Akademii Nauk SSSR, Vol XXXXVI, No 4, 1946, p 158. 4. Bezikovich, Ya. S., <u>The Calculus of Finite Differences</u>, Publishing House of Leningrad State University, 1939. 5. Borisov, W. P., "Deflection of Bullets From the Target Caused by Vibrations of an Airplane in Firing a Burst," Trudy LK VVIAKA /Teningrad Red Banner Air Force Engineering Academy of the Red Army 7, No 7, 1945, p 67. STAT



- 3 -

6. Buylov, A. Ya., Principles of Electrical Equipment Building, Gosenergoizdat,

8. Bulgakov, B. V., "Some Problems on the Theory of Regulation With Monlinear Characteristics," Prikladnaya Matematika i Mekhanika, Vol X, No 3, 1946,

9. Gardner, M. F., and Berns, D. L., Transient Processes in Linear Systems,

7. Bulgakov, B. V., Oscillations, Vol I, Gostekhizdat, 1949.

Gostekhizdat, 1949.

## RESTRICTED

RESTRICTED

- 10. Gel'fond, A. O., The Calculus of Finite Differences, Vol I, ONTI, 1935.
- Gershenovich, G. B., "An Investigation of Automatic Temperature Regulation on an Airplane," <u>Trudy LII</u> (Leningrad Industrial Institute), published by the Bureau of Technical Information, Ministry of the Aviation Industry, 1946.
- Gol'dfarb, L. S., "Some Monlinearities in Systems of Automatic Regulation", <u>Avtomatika i Telemekhanika</u>, Vol VIII, No 5, 1947, p 344.
- Gol'dfarb, L. S., "The Problem of the Theory of Vibration Regulators," <u>Avtomatika i Telemekhanika</u>, Vol IX, No 6, 1948, p 413.
- Yevtyanov, S. I., <u>Transient Processes in Receiving-Amplifying Circuits</u>, Svyaz'izint, 1948.
- Motes of the Seminar on the Theory of Stability. edited by N. D. Moiseyev, Publishing House of the Air Force Academy imeni Zhukovskiy, No 3, 1948.
- Karman, T. V. and Biot, M., <u>Mathematical Methods in Engineering</u>, Gostekhizdat, 1946.
- 17. Kolosov, A. A., Resonance Systems and Resonance Amplifiers, Svyzz'izdat, 1949.
- Kontorovich, M. I., Operator Calculus and Transients in Electric Circuits Gostekhizdat, 1949.
- Kornilov, Yu. G., "An Analytical Theory of Discontinuous Regulation," Inzhenernyy Sbornik, Vol I, No 2, 1941, p 287.
- 20. Kornilov, Yu. G., and Piven', V. D., Principles of the Theory of Automatic Regulation, Mashgiz, 1947.
  - 21. Kurg, K. A., Transient and Steady-State Processes in Linear Electric Circuits, Gosenergoizdat, 1948.
  - Livshits, N. A., Spitsyn, D. V., and Danilin, A. V., Theory and Calculation
    of Elements of Automatic Systems (Relays), published by the Military Electrical Engineering Academy, 1939.
  - Lur'ye, A. I., Operator Calculus as Applied to Mechanics Problems, Gostekhizdat, 1938.
- 24. Lur'ye, A. I., "Self-Excited Oscillations in Some Regulated Systems," <u>Avtomatika i Telemekhanika</u>, Vol VIII, No 5, 1947, p 335.
- 25. Lur 'ye, A. I., "Stability of Self-Excited Oscillation in Some Regulated Systems," Avtomatika 1 Telemekhanika, Vol IX, No 5, 1948, p 301
- Lur'ye, A. I., "Periodic Solution of a System of Linear Differential Equations With Constant Coefficients," <u>Trudy</u> TsNII (Central Scientific-Research Institute) imeni Acad A. N. Krylov, No 29, 1948.
- Lur'ye, O. B., "Transients in Wide-Band Amplifiers," Zhurnal Tekhnicheskoy, Fiziki, Vol VI, No 2, 1936, p 319.
- Lur'ye, O. B., "Distortions "-troduced by the Low-Frequency Amplifier in Television," <u>Zhurnal Tekhnicheskoy Fiziki</u>, Vol VIII, No 17, 1938, p 1562.

- - -

STAT



## RESTRICTED

- 29 MacColl, Fundamental Theory of Servomechanisms, Incident, 1947.
- Markov, A. A., <u>The Calculus of Finite Parferences</u>, Materia Publishing House, 1911.
- Nikol'skiy, G. N., "Corcerning a Problem of Indirect Regulation," <u>In-zhenernyy Sbornik</u>, Vol IV, No 2, 1948, p 113.
- 32. Ol'denburg, R., and Sartorius, G., The Dynamics of Automatic Regulation, Gosenergoizdat, 1949.
- Privalov, I. I., Introduction to the Theory of Functions of a Complex Variable, Gostekhizdat, 1949.
- 34. Radar Rectivers, Parts 1 and 2, translation under the editorship of A. P. Sivers, "Sovetskoye Radio" Publishing House 1949.
- Fel'dbaum, A. A., "Integral Criteria of Regulation Quality," <u>Avtomatika</u>
   Telemekhanika, Vol X, No 1, 1948, p 3.
- 36. Fel'dbaum, A. A., <u>Introduction to the Theory of Nonlinear Circuits</u>, Gosenergoizdat, 1948.
- 37. Fel'dbaum, A. A., "The Simplest Relay Systems for Automatic Regulation,"

  Avtomatika 1 Telemekhanika, Vol X, No 4, 1949, p 249.
- 38. Fikhtengol'ts, S. M., A Course in Differential and Integral Calculus, Vol II, Gostekhizdat, 1948.
- 39. Fuks, B. A., and Shabat, B. V., Functions of a Complex Variable, Gostekhizdat, 1949.
- 40. Tsypkin, Ya. Z., and Bromberg, N. V., "The Degree of Stability of Linear Systems," Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, No 12, 1945, p 1161.
- 41. Tsypkin, Ya. Z., "Stability and the Degree of Stability of Discontinuous Regulation Systems," <u>Avtomatika i Telemekhanika</u>, Vol IX, No 2, 1948, p 143.
- 42. Tsypkin, Ya. Z., "The Theory of Discontinuous Regulation," Parts I, II, and III, Avtomatika i Telemekhanika, Vol X, No 3, 1949, p 189; Vol X, No 5, 1949, p 342; Vol XI, No 5, 1950, p 300.
- 43. Yur'yev, M. I., Steady-State Conditions in Four-Terminal Networks, Energoizdat, 1936.
- 44. Faust, R., and Beck, H., "Oscillation Conditions in Single-Tuned Amplifiers," <u>Journal of Applied Physics</u>, Vol XVII, No 9, p 749, 1946.
- 45. Theory of Servomechanisms, James, Nichols, and Phillips, 1947.

- E N D -

- 5 -

RESTRICTED

STAT

